

# Informational Leaflet 130

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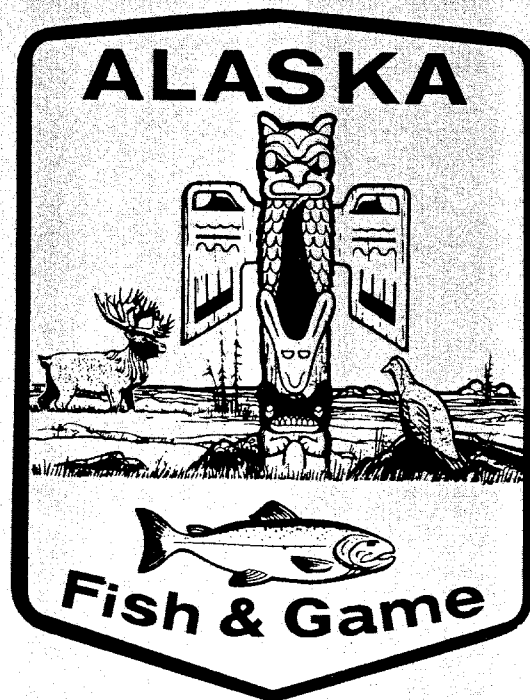
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**DEPARTMENT OF  
FISH AND GAME**

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# STUDIES OF ADULT CHIGNIK SOCKEYE SALMON IN 1967

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## INTRODUCTION

The Fisheries Research Institute and the Alaska Department of Fish and Game have cooperated in various studies of adult Chignik salmon to obtain information on which to base the management of the two stocks (Black Lake and Chignik Lake) that make up the run. The main objectives of studies have been to provide information for each stock annually on the time of entry into the fishery, the age composition of catch and escapement, the length frequency of component age classes of the catch, and the potential egg deposition (based on fecundity determinations). Additionally, in 1966 and 1967, the length-weight relationship was determined.

The results of studies conducted in 1967 are presented in this report.

The Alaska Department of Fish and Game collected samples of scales and lengths from the commercial fishery and determined the sex ratio. The Fisheries Research Institute determined the age composition of the escapement from otolith samples collected from the major spawning colonies and made the fecundity determinations. The two agencies cooperated in the

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tagging and recovery program to determine time of entry of the stocks. Analyses were performed in Seattle by the Fisheries Research Institute.

## TIME OF ENTRY OF THE STOCKS

The Chignik River system is comprised of two lakes, Black Lake (upper) and Chignik Lake (lower), each of which is a nursery area for a discreet stock of sockeye salmon. The enumeration of the catch and escapement of the two stocks is complicated because both pass through the same fishing area and trunk stream as they return to spawn, and their time of passage overlap to a certain extent. The earliest fish are bound for Black Lake spawning areas and the latest fish for Chignik Lake areas, but Chignik Lake fish begin entering the fishery before the Black Lake fish have all entered, and for about three weeks fish of both stocks enter together. A tagging-and-recovery program has been undertaken annually over a period of years for the purpose of defining the proportion of the two stocks in the catch and escapement on a given day. Dahlberg (1968) has summarized the results of all studies through 1966.

### Procedures

An attempt is made each year to tag 300 adult sockeye with a 1-inch Petersen disc tag on each of six or seven days either in Chignik Lagoon or at the ADF&G weir on the lower end of Chignik River, the trunk stream. A unique color is used for each tagging session so that a visual observation of a tag is sufficient to know when it was tagged. Recovery is by foot survey of the major spawning streams of both lakes and by boat survey of the spawning beaches of Chignik Lake.

The percentage of tags observed on early (Black Lake) and late (Chignik Lake) sockeye salmon are computed for each tagging session. Because there is an average delay of almost two days between the lagoon and the weir, the dates of all tagging sessions conducted in the lagoon are adjusted to agree with the dates of sessions at the weir. On the basis of these percentages, the total catch and escapement are divided between the two stocks by means of a computer program written by Dahlberg (1967) and according to the equation

$$P = \frac{1}{1 + e^{-(a+bt)}},$$

where  $\underline{P}$  = proportion of Chignik Lake fish,  
 $1-\underline{P}$  = proportion of Black Lake fish,  
 $\underline{e}$  = base of Napierian system of logarithms,  
 $\underline{t}$  = time in days measured from day 1 = June 15, and  
 $\underline{a}$  and  $\underline{b}$  = parameters estimated from tagging studies.

The percentages can be plotted for a graphical presentation of the time of entry for the year for comparison with the pattern in other years, as is done in Figures 1 and 2.

### Results

A total of 1,595 Petersen disc tags was placed on adult sockeye on 6 days, and 221 (13.9%) of these tags were recovered on the spawning grounds (Table 1). In addition, 1,152 Floy tags (Dell, 1968) were placed on fish on 2 days; only 16 (1.4%) of these tags were recovered. The low recovery rate for the Floy tags is a result of their small size (hence, their restricted visibility on the spawning grounds), and tag loss. Many of the fish tagged with both the Y/Y Petersen disc tag and orange Floy tag that were recovered had lost the Floy tag; others could be pulled out with little effort. Adequate techniques for application of the tag on adult salmon have not been developed. The recovery rate of 13.9% for the Petersen disc tags is somewhat higher than normal because the recovery effort was greater than before.

The time-of-entry pattern for 1967 (Figure 1) has the same configuration as the patterns for other years (Figure 2), falling on the left-hand (early) side of the distribution of curves.

### AGE COMPOSITION OF THE RUN

The age composition of the run must be determined so that returns can be assigned proportionately to their year of origin. Knowledge of the number of returns from a given parent year is requisite to evaluating the success of spawning escapements of different magnitudes. The age composition is also used in the forecast of the magnitude of the next year's run of adult salmon.

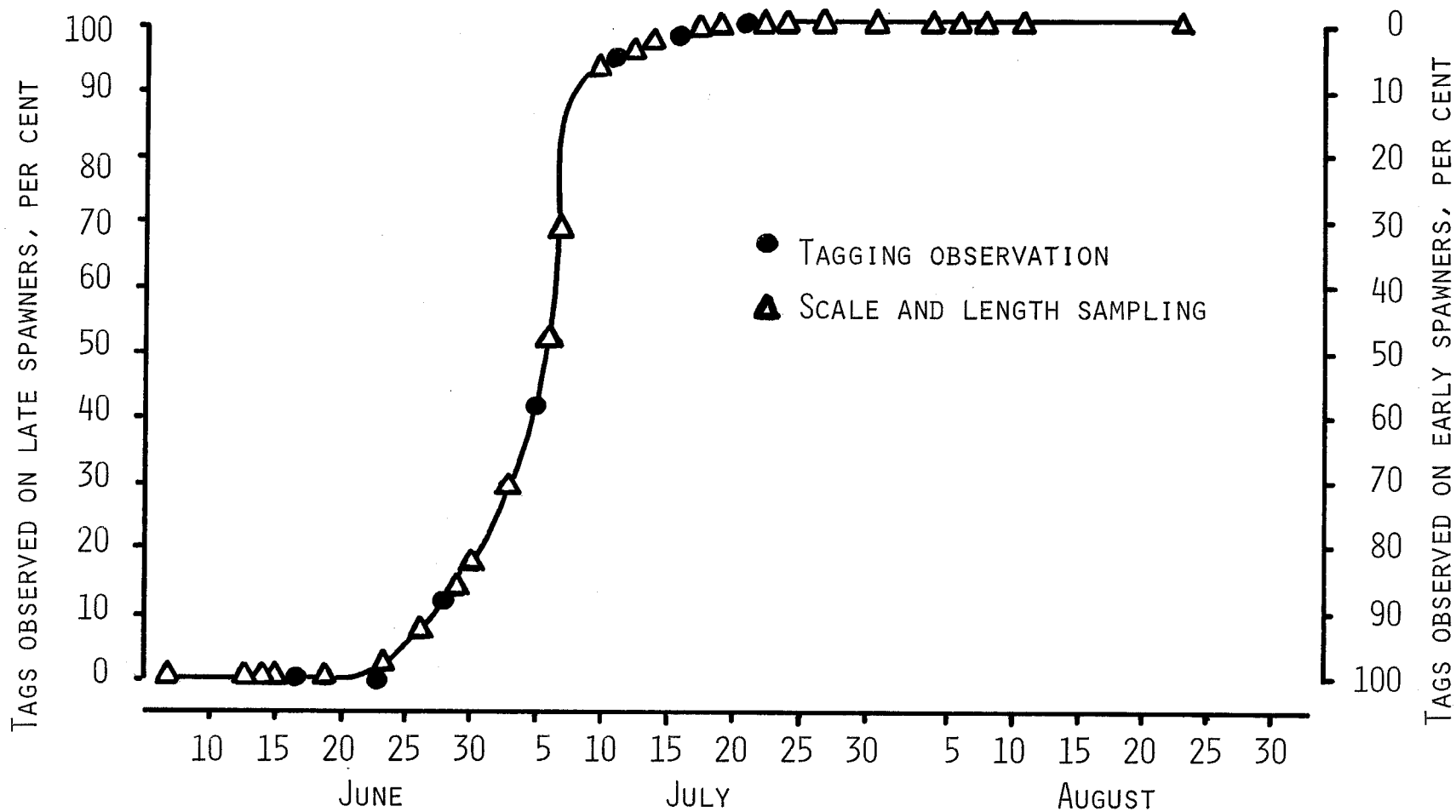


FIGURE 1. PATTERN OF TIME OF ENTRY FOR BLACK LAKE AND CHIGNIK LAKE STOCKS DURING 1967. SAMPLE DATES SUPERIMPOSED ON THE CURVE SHOW DISTRIBUTION OF SCALE AND LENGTH SAMPLING EFFORT FOR THE YEAR.

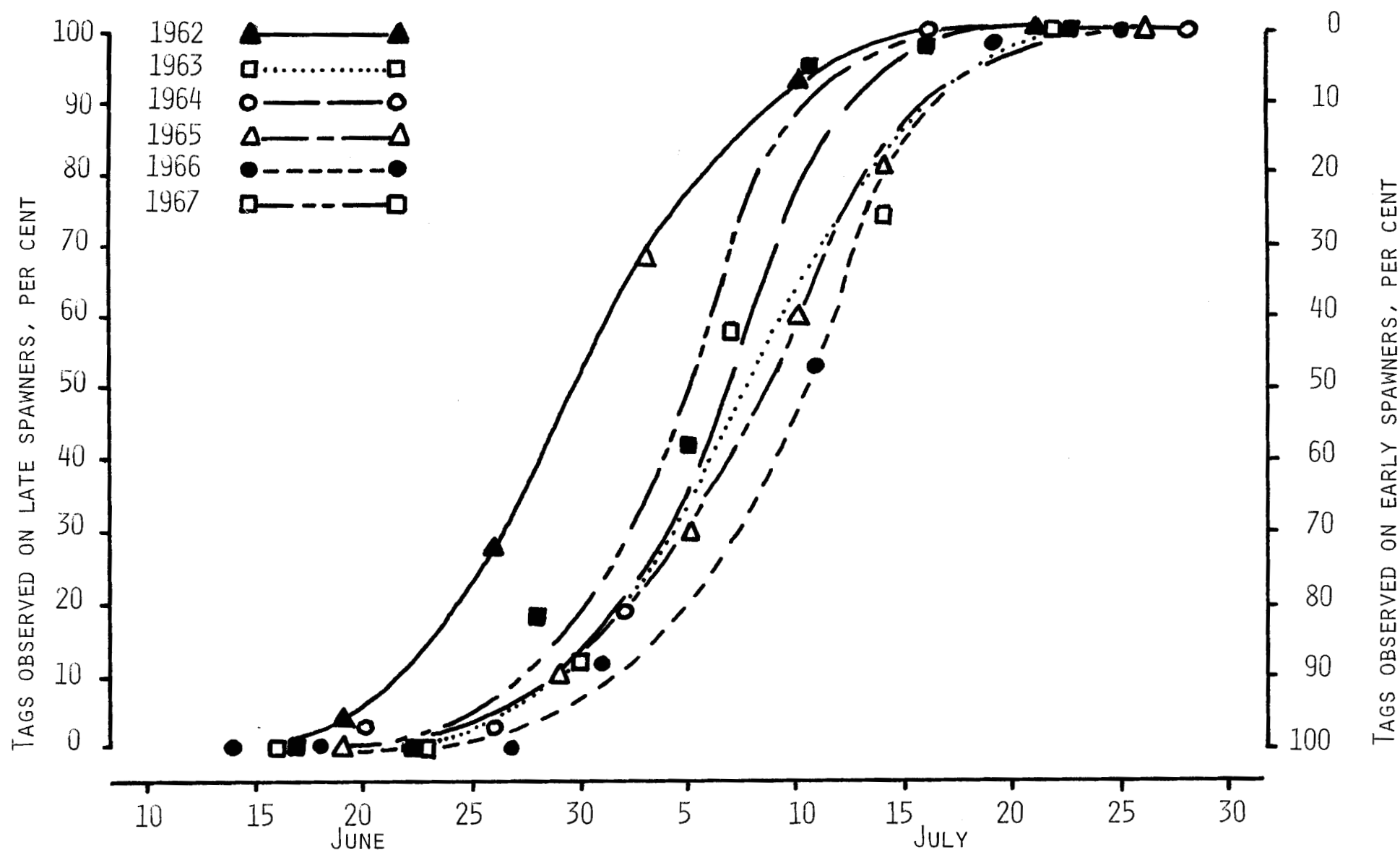


FIGURE 2. PATTERN OF TIME OF ENTRY FOR BLACK LAKE AND CHIGNIK LAKE STOCKS, 1962-1967.

TABLE 1. SUMMARY OF RELEASES AND RECOVERIES OF CHIGNIK SOCKEYE SALMON, 1967  
TIME-OF-ENTRY TAGGING

Tag Color	Date	Tagging Location	Number Tagged	Number Recovered	Per Cent Recovered	Per Cent Recovered on Late Fish
R/G	June 17 & 18	Weir	223	36	16.1	0
Red Floy	June 21	Lagoon	1,000	14	1.4	0
Y/Y + Orange Floy	June 28	Weir	258	51	19.8	18
B/W	July 5	Weir	238	33	13.9	42
White Floy	July 11	Lagoon	152	2	1.3	100
G/G	July 11	Weir	323	21	6.5	95
W/W	July 16	Weir	226	41	18.1	98
R/R	July 21	Weir	327	39	11.9	100
TOTALS						
Floy Tags			1,152	16	1.4	
Petersen Disc Tags			1,595	221	13.9	
GRAND TOTAL			2,747	237	8.6	

## Materials and Methods

Scale samples were taken from catches of the commercial fishery and those taken for personal use on 26 days in 1967 (Figure 1 and Table 2). Scales were placed on gummed cards in the field and later impressed in plastic (Koo, 1962) for age analysis.

Otoliths were taken from a sample of fish from each of the major spawning colonies of sockeye salmon (Table 3). Each sample was taken near the peak of spawning and consisted of both dead, spawned out fish and speared live fish. (We often found spearing of live fish necessary to obtain an adequate sample.) Otoliths were stored dry in the field and later mounted according to the method of Kim (1963), except that Customount 5 was the mounting medium used. Age determinations were made with the aid of a dissecting microscope and reflected light.

We used computer programs written by Dr. M.L. Dahlberg to assign the catch and escapement to age classes for each stock. Daily and total age composition in percentage of numbers were computed.

## Results

The age composition of the run in 1967 (numbers and percentages) by stock, sex, catch, escapement, total run, ocean age, and freshwater age are presented in Tables 4-9. Daily figures are available in the archives of the Fisheries Research Institute. A summary of the otolith age readings by stock, spawning colony, and sex is presented in Table 10.



TABLE 2. SUMMARY OF SCALE SAMPLES TAKEN FROM THE COMMERCIAL CATCH IN CHIGNIK LAGOON, 1967

Date	Number of Scales Collected			Number of Readable Scales			Sex Ratio	
	Males	Females	Total	Males	Females	Total	Males	Females
June 7	20	20	40	16	18	34	.4706	.5294
13	57	60	117	49	60	109	.4495	.5505
14	91	65	156	78	59	137	.5693	.4307
15	50	50	100	45	47	92	.5000	.5000 <sup>a/</sup>
19	141	161	302	123	145	268	.4590	.5410
23	118	127	245	106	116	222	.4775	.5225
26	144	157	301	124	143	267	.4644	.5356
28	81	120	201	71	109	180	.3944	.6056
30	69	118	187	59	108	167	.3533	.6467
July 3	153	180	233	138	165	303	.455	.5446
6	150	154	304	131	134	265	.4943	.5057
7	147	153	300	123	136	259	.4749	.5251
10	129	166	295	112	146	258	.4341	.5659
12	134	134	268	114	146	260	.4385	.5615
14	52	59	111	46	55	101	.4555	.5446
17	126	170	296	116	144	260	.4462	.5539
19	113	184	297	97	154	251	.3865	.6136
21	43	58	101	39	50	89	.4382	.5618
24	139	159	298	119	139	258	.4612	.5388
27	37	60	97	34	54	88	.3864	.6136
31	97	143	230	81	127	208	.3894	.6106
Aug. 4	91	150	241	81	131	212	.3821	.6179
6	80	113	193	72	103	175	.4114	.5886
8	47	53	100	45	48	93	.4839	.5161
11	160	173	333	136	139	275	.4946	.5055
23	6	13	19	6	13	19	.3158	.6842

<sup>a/</sup>Sample was designed to contain an equal number of each sex.

TABLE 3. SUMMARY OF SAMPLES OF OTOLITHS COLLECTED FROM SPAWNERS  
ON THE MAJOR SPAWNING GROUNDS OF CHIGNIK, 1967

Area	Date of Sampling	Number of Otoliths Collected		Number of Readable Otoliths	
		Male	Female	Male	Female
<u>Black Lake</u>					
Fan Creek	August 2, 8, & 16	138	93	137	92
Milk Creek	August 13	65	60	65	60
Boulevard Creek	August 14 & 15	117	117	116	117
Broad Creek	August 14 & 16	62	59	62	59
Big Spring	August 14 & 16	70	70	70	70
Alec River	August 16	100	100	99	100
Subtotal		552	499	549	498
<u>Black River</u>					
West Fork	August 11 & 18	128	166	128	164
Chiaktuak Creek (early)	August 1 & 12	105	97	104	97
Chiaktuak Creek (late)	August 24	5	3	5	3
Subtotal		238	266	237	264
<u>Chignik Lake</u>					
N. Hatchery Beach	September 2	100	86	100	86
S. Hatchery Beach	September 2	100	80	100	79
Clark River		97	94	96	93
Subtotal		297	260	296	258
TOTAL		1,087	1,025	1,082	1,020
GRAND TOTAL		2,112		2,102	

TABLE 4. AGE COMPOSITION OF RETURNS IN 1967, BLACK LAKE SOCKEYE SALMON

		Age Group											Total	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4		3.4
<u>Commercial Catch</u>														
Males														
Per Cent		0.02	0.12	0	13.75	9.93	0.15	48.42	27.41	<0.01	0.12	0.08	0	
Number		10	54	0	6,481	4,681	71	22,819	12,914	4	54	36	0	47,124
Females														
Per Cent		0	0	0	1.48	4.67	0.23	46.29	44.66	2.17	0.22	0.28	0	
Number		0	0	0	855	2,693	134	26,726	25,786	1,251	126	164	0	57,734
Total Both Sexes														
Per Cent		0.01	0.05	0	7.00	7.03	0.20	47.25	36.90	1.20	0.17	0.19	0	
Number		10	54	0	7,336	7,374	205	49,545	38,699	1,255	180	200	0	104,858
		<u>Escapement</u>												
Males														
Per Cent		<0.01	0.03	0	11.56	6.50	0.03	58.28	23.54	<0.01	0.03	0.03	0	
Number		5	36	0	13,841	7,785	38	69,815	28,200	3	36	24	0	119,784
Females														
Per Cent		0	0	0	1.68	2.79	0.09	57.66	36.88	0.61	0.13	0.16	0	
Number		0	0	0	2,276	3,783	118	78,235	50,046	830	182	213	0	135,684
Total Both Sexes														
Per Cent		<0.01	0.01	0	6.31	4.53	0.06	57.95	30.63	0.33	0.09	0.09	0	
Number		5	36	0	16,117	11,569	156	148,050	78,246	833	218	237	0	255,467

TABLE 4. AGE COMPOSITION OF RETURNS IN 1967, BLACK LAKE SOCKEYE SALMON

- Continued -

		Age Group												Total	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	3.4		
<u>Total Return</u>															
Males															
Per Cent		0.01	0.05	0	12.18	7.47	0.07	55.50	24.63	<0.01	0.05	0.04	0		
Number		15	90	0	20,323	12,466	109	92,634	41,114	7	90	61	0	166,908	
Females															
Per Cent		0	0	0	1.62	3.35	0.13	54.27	39.21	1.07	0.16	0.19	0		
Number		0	0	0	3,130	6,476	252	104,961	75,832	2,081	308	377	0	193,418	
Total Both Sexes															
Per Cent		<0.01	0.03	0	6.51	5.26	0.10	54.84	32.45	0.58	0.11	0.12	0		
Number		15	90	0	23,453	18,942	361	197,595	116,946	2,088	398	437	0	360,326	

TABLE 5. AGE COMPOSITION OF RETURNS IN 1967, BLACK LAKE SOCKEYE SALMON, SUMMARIZED BY  
OCEAN AGE AND FRESH WATER AGE

		Age Group							
		1.	2.	3.	.1	.2	.3	.4	Total
<u>Commercial Catch</u>									
Males									
Per Cent		62.31	37.53	0.16	0.14	23.84	75.83	0.19	
Number		29,364	17,685	75	64	11,234	35,736	90	47,124
Females									
Per Cent		47.99	49.61	2.40	0	6.38	93.12	0.50	
Number		27,707	28,642	1,385	0	3,682	53,763	290	57,734
Total Both Sexes									
Per Cent		54.43	44.18	1.39	0.06	14.23	85.35	0.36	
Number		57,071	46,327	1,460	64	14,915	89,499	380	104,858
<u>Escapement</u>									
Males									
Per Cent		69.88	30.09	0.03	0.03	18.09	81.83	0.05	
Number		83,697	36,046	41	41	21,665	98,019	60	119,784
Females									
Per Cent		59.47	39.83	0.70	0	4.55	95.16	0.29	
Number		80,693	54,042	948	0	6,177	129,111	395	135,684
Total Both Sexes									
Per Cent		64.35	35.26	0.39	0.02	10.90	88.90	0.18	
Number		164,390	90,088	989	41	27,842	227,130	455	255,467

TABLE 5. AGE COMPOSITION OF RETURNS IN 1967, BLACK LAKE SOCKEYE SALMON, SUMMARIZED BY  
OCEAN AGE AND FRESH WATER AGE

- Continued -

	Age Group							
	1.	2.	3.	.1	.2	.3	.4	Total
	<u>Total Return</u>							
Males								
Per Cent	67.74	32.19	0.07	0.06	19.71	80.14	0.09	
Number	113,061	53,731	116	105	32,898	133,755	150	166,908
Females								
Per Cent	56.04	42.75	1.21	0	5.10	94.55	0.35	
Number	108,400	82,684	2,334	0	9,859	182,874	685	193,418
Total Both Sexes								
Per Cent	61.46	37.86	0.68	0.03	11.87	87.87	0.23	
Number	221,461	136,415	2,449	105	42,757	316,629	835	360,326

TABLE 6. AGE COMPOSITION OF RETURNS IN 1967, CHIGNIK LAKE SOCKEYE SALMON

		Age Group											Total	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4		3.4
<u>Commercial Catch</u>														
Males														
Per Cent		0.04	0.57	0	3.68	18.42	0.51	12.54	62.46	0.63	0.85	0.30	0	
Number		53	870	0	5,632	28,160	781	19,166	95,486	963	1,306	450	0	152,869
Females														
Per Cent		0	0.54	0	0.21	7.77	0.51	11.50	75.82	3.28	0.02	0.34	0	
Number		0	1,111	0	430	15,855	1,046	23,474	154,734	6,698	43	683	0	145,167
Total Both Sexes														
Per Cent		0.02	0.56	0	1.70	12.33	0.51	11.95	70.10	2.14	0.38	0.31	0	
Number		53	1,981	0	6,062	44,015	1,827	42,641	250,221	7,661	1,349	1,133	0	356,943
<u>Escapement</u>														
Males														
Per Cent		0.03	0.28	0	5.75	13.99	0.25	27.06	51.81	0.30	0.39	0.14	0	
Number		31	332	0	6,718	16,350	287	31,640	60,567	350	461	168	0	116,903
Females														
Per Cent		0	0.28	0	0.62	5.40	0.27	25.26	65.24	2.61	0.04	0.28	0	
Number		0	411	0	898	7,842	385	36,670	94,701	3,792	63	406	0	145,167
Total Both Sexes														
Per Cent		0.01	0.28	0	2.91	9.23	0.26	26.06	59.25	1.58	0.20	0.22	0	
Number		31	743	0	7,616	24,192	672	68,310	155,268	4,142	523	574	0	262,070

TABLE 6. AGE COMPOSITION OF RETURNS IN 1967, CHIGNIK LAKE SOCKEYE SALMON

- Continued -

		<u>Age Group</u>											<u>Total</u>	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4		3.4
		<u>Total Return</u>												
Males														
Per Cent		0.03	0.44	0	4.58	16.50	0.40	18.83	57.85	0.49	0.65	0.23	0	
Number		85	1,201	0	12,350	44,510	1,068	50,806	156,053	1,313	1,767	618	0	269,772
Females														
Per Cent		0	0.44	0	0.38	6.79	0.41	17.22	71.42	3.00	0.03	0.31	0	
Number		0	1,522	0	1,327	23,697	1,431	60,144	249,435	10,490	105	1,089	0	349,241
Total Both Sexes														
Per Cent		0.01	0.44	0	2.21	11.02	0.40	17.92	65.51	1.91	0.30	0.28	0	
Number		85	2,724	0	13,678	68,207	2,499	110,951	405,488	11,803	1,872	1,707	0	619,013



TABLE 7. AGE COMPOSITION OF RETURNS IN 1967, CHIGNIK LAKE SOCKEYE SALMON, SUMMARIZED  
BY OCEAN AGE AND FRESH WATER AGE

	Age Group							Total
	1.	2.	3.	.1	.2	.3	.4	
<u>Commercial Catch</u>								
Males								
Per Cent	17.11	81.75	1.14	0.60	22.62	75.63	1.15	
Number	26,158	124,966	1,744	923	34,574	115,615	1,756	152,869
Females								
Per Cent	11.73	84.47	3.80	0.54	8.49	90.61	0.36	
Number	23,947	172,383	7,744	1,111	17,331	184,907	726	204,074
Total Both Sexes								
Per Cent	14.04	83.30	2.66	0.57	14.54	84.19	0.70	
Number	50,105	297,350	9,488	2,034	51,904	300,522	2,482	356,943
<u>Escapement</u>								
Males								
Per Cent	33.23	66.22	0.55	0.31	19.98	79.17	0.54	
Number	38,850	77,417	637	363	23,355	92,557	629	116,903
Females								
Per Cent	25.92	71.20	2.88	0.28	6.29	93.11	0.32	
Number	37,630	103,359	4,178	411	9,125	135,163	468	145,167
Total Both Sexes								
Per Cent	29.18	68.98	1.84	0.30	12.39	86.89	0.42	
Number	76,480	180,776	4,814	774	32,480	227,720	1,097	262,070

TABLE 7. AGE COMPOSITION OF RETURNS IN 1967, CHIGNIK LAKE SOCKEYE SALMON, SUMMARIZED  
BY OCEAN AGE AND FRESH WATER AGE

- Continued -

		Age Group						Total	
		1.	2.	3.	.1	.2	.3		.4
		<u>Total Return</u>							
Males									
Per Cent		24.10	75.02	0.88	0.48	21.47	77.17	0.88	
Number		65,008	202,383	2,381	1,286	57,928	208,173	2,385	269,772
Females									
Per Cent		17.63	78.96	3.41	0.43	7.58	91.65	0.34	
Number		61,577	275,743	11,921	1,522	26,455	320,069	1,194	349,241
Total Both Sexes									
Per Cent		20.45	77.24	2.31	0.45	13.63	85.34	0.58	
Number		126,585	478,126	14,302	2,808	84,384	528,242	3,579	619,013

TABLE 8. AGE COMPOSITION OF COMBINED RETURNS IN 1967, BLACK LAKE AND CHIGNIK LAKE  
SOCKEYE SALMON

		Age Group											Total	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4		3.4
<u>Commercial Catch</u>														
Males														
Per Cent		0.03	0.46	0	6.06	16.42	0.43	20.99	54.20	0.48	0.68	0.25	0	
Number		64	924	0	12,114	32,841	852	41,985	108,400	966	1,360	487	0	199,993
Females														
Per Cent		0	0.42	0	0.49	7.08	0.45	19.18	68.95	3.04	0.07	0.32	0	
Number		0	1,111	0	1,284	18,548	1,180	50,201	180,520	7,949	169	847	0	261,808
Total Both Sexes														
Per Cent		0.01	0.44	0	2.90	11.13	0.44	19.96	62.57	1.93	0.33	0.29	0	
Number		64	2,035	0	13,398	51,389	2,032	92,186	288,920	8,915	1,529	1,333	0	461,801
<u>Escapement</u>														
Males														
Per Cent		0.02	0.16	0	8.69	10.20	0.13	42.86	37.50	0.15	0.21	0.08	0	
Number		36	368	0	20,559	24,135	325	101,455	88,767	353	496	192	0	236,687
Females														
Per Cent		0	0.15	0	1.13	4.14	0.18	40.91	51.54	1.64	0.09	0.22	0	
Number		0	411	0	3,173	11,625	504	114,905	144,747	4,622	245	619	0	280,851
Total Both Sexes														
Per Cent		0.01	0.15	0	4.58	6.91	0.16	41.80	45.12	0.96	0.15	0.16	0	
Number		36	779	0	23,732	35,761	828	216,360	233,514	4,976	741	811	0	517,538

TABLE 8. AGE COMPOSITION OF COMBINED RETURNS IN 1967, BLACK LAKE AND CHIGNIK LAKE  
SOCKEYE SALMON

- Continued -

		<u>Age Group</u>											<u>Total</u>	
		1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4		3.4
		<u>Total Return</u>												
Males														
Per Cent		0.02	0.30	0	7.48	13.05	0.27	32.85	45.15	0.30	0.42	0.16	0	
Number		99	1,291	0	32,673	56,977	1,177	143,440	197,167	1,320	1,856	679	0	436,680
Females														
Per Cent		0	0.28	0	0.82	5.56	0.31	30.42	59.94	2.32	0.08	0.27	0	
Number		0	1,522	0	4,458	30,173	1,684	165,105	325,267	12,571	414	1,465	0	542,659
Total Both Sexes														
Per Cent		0.01	0.29	0	3.79	8.90	0.29	31.51	53.34	1.42	0.23	0.22	0	
Number		99	2,814	0	37,131	87,149	2,860	308,546	522,434	13,891	2,270	2,144	0	979,339

TABLE 9. AGE COMPOSITION OF THE 1967 COMBINED BLACK LAKE AND CHIGNIK LAKE SOCKEYE SALMON STOCKS, SUMMARIZED BY OCEAN AGE AND FRESH WATER AGE

	Age Group							Total
	1.	2.	3.	.1	.2	.3	.4	
<u>Commercial Catch</u>								
Males								
Per Cent	27.76	71.33	0.91	0.50	22.90	75.68	0.92	
Number	55,523	142,652	1,819	988	45,807	151,351	1,847	199,993
Females								
Per Cent	19.73	76.78	3.49	0.42	8.03	91.16	0.39	
Number	51,654	201,025	9,129	1,111	21,012	238,669	1,015	261,808
Total Both Sexes								
Per Cent	23.21	74.42	2.37	0.45	14.47	84.46	0.62	
Number	107,176	343,677	10,948	2,099	66,819	390,021	2,862	461,801
<u>Escapement</u>								
Males								
Per Cent	51.78	47.94	0.28	0.17	19.02	80.52	0.29	
Number	122,547	113,463	678	403	45,019	190,576	689	236,687
Females								
Per Cent	42.13	56.04	1.83	0.14	5.45	94.10	0.31	
Number	118,323	157,402	5,126	411	15,302	264,274	864	280,851
Total Both Sexes								
Per Cent	46.54	52.34	1.12	0.16	11.65	87.89	0.30	
Number	240,870	270,864	5,804	814	60,321	454,850	1,552	517,538

TABLE 9. AGE COMPOSITION OF THE 1967 COMBINED BLACK LAKE AND CHIGNIK LAKE SOCKEYE  
SALMON STOCKS, SUMMARIZED BY OCEAN AGE AND FRESH WATER AGE

- Continued -

	Age Group							Total
	1.	2.	3.	.1	.2	.3	.4	
	<u>Total Return</u>							
Males								
Per Cent	40.78	58.65	0.57	0.32	20.80	78.30	0.58	
Number	178,069	256,114	2,496	1,391	90,826	341,927	2,535	436,680
Females								
Per Cent	31.32	66.05	2.63	0.28	6.69	92.68	0.35	
Number	169,977	358,427	14,255	1,522	36,314	502,943	1,879	542,659
Total Both Sexes								
Per Cent	35.54	62.75	1.71	0.30	12.98	86.27	0.45	
Number	348,046	614,541	16,751	2,913	127,141	844,870	4,415	979,339

TABLE 10. NUMBERS OF FISH IN THE MAJOR AGE CLASSES FROM 1967 CHIGNIK SPAWNING GROUND  
OTOLITH SAMPLING

		Age Group								Total
Sex		1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	
<u>Black Lake</u>										
Fan Creek	Male	90	2	0	40	4	0	1	0	137
	Female	7	0	0	75	9	0	1	0	92
Milk Creek	Male	22	0	0	36	7	0	0	0	65
	Female	1	0	0	51	7	0	1	0	60
Boulevard Creek	Male	35	1	0	75	5	0	0	0	116
	Female	4	0	0	107	6	0	0	0	117
Broad Creek	Male	8	0	0	49	5	0	0	0	62
	Female	1	0	0	55	2	0	1	0	59
Big Spring	Male	8	0	0	62	0	0	0	0	70
	Female	5	1	1	60	3	0	0	0	70
Alec River	Male	15	0	0	83	0	0	1	0	99
	Female	0	0	0	95	3	0	2	0	100
Subtotal	Male	178	3	0	345	21	0	2	0	569
	Female	18	1	1	443	30	0	5	0	498
<u>Black River</u>										
West Fork	Male	4	1	0	39	84	0	0	0	128
	Female	1	1	0	48	114	0	0	0	164
Chiaktuak Creek (early)	Male	2	2	0	68	31	1	0	0	104
	Female	4	0	0	49	40	4	0	0	97
Chiaktuak Creek (late)	Male	0	0	0	0	5	0	0	0	5
	Female	0	1	0	1	1	0	0	0	3
Subtotal	Male	6	3	0	107	120	1	0	0	237
	Female	5	2	0	98	155	4	0	0	264

TABLE 10. NUMBERS OF FISH IN THE MAJOR AGE CLASSES FROM 1967 CHIGNIK SPAWNING GROUND  
OTOLITH SAMPLING

- Continued -

		Age Group								Total
Sex		1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	
<u>Chignik Lake</u>										
N. Hatchery Beach	Male	0	26	0	1	67	6	0	0	100
	Female	0	11	0	4	59	12	0	0	86
S. Hatchery Beach	Male	0	19	0	5	65	11	0	0	100
	Female	0	6	0	8	57	8	0	0	79
Clark River	Male	8	17	0	18	51	1	0	1	96
	Female	1	1	0	26	56	8	0	1	93
Subtotal	Male	8	62	0	24	183	18	0	1	296
	Female	1	18	0	38	172	28	0	1	258
TOTAL	Male	192	68	0	476	324	19	2	1	1,082
	Female	24	21	1	579	357	32	5	1	1,020



## LENGTH FREQUENCY OF 1967 RETURNS

Length measurements (mideye to tailfork) were taken concurrently with scale samples in the commercial fishery. The samples were assigned to stock by time of entry. For the purpose of tabulating the length frequency of the stocks, all fish sampled on and before June 28 were considered of Black Lake stock and all those taken from July 12 on were considered of Chignik Lake stock. These dates are taken as cutoff points because, prior to June 28, over 90% of the fish were of Black Lake stock and, on July 12, 90% of the fish were of Chignik Lake stock (Figure 1). All length measurements, including those taken between the above two dates, were included in the calculation of the combined length frequencies. The length frequencies, classified by stock, sex, and ocean age, are presented in Figures 3-5. All samples were taken from the commercial fishery catch, but the fishery is apparently non-selective for size; thus, the lengths are assumed to be representative of the entire run.

The general pattern of the distributions is very similar to that of the run in 1966 (Dahlberg and Phinney, 1967). The bimodal nature of the distribution of the combined sample of .2 males is repeated, as are the long tails of some of the other distribution (e.g., age .2 Chignik Lake males).

## FECUNDITY STUDY

Estimates of the fecundity relationships for a fish stock are necessary in studies of the population dynamics and may be useful as a racial characteristic. A few fecundity samples have been taken from Chignik sockeye salmon, and the analysis of the data on these samples is summarized and presented here.

### Processing of Samples

Samples of adult sockeye salmon were taken from the commercial fishery catch or by beach seine in the lakes. Each fish was weighed to the nearest 10 g and measured, in millimeters, from mideye to tailfork. Either a scale or an otolith was taken for age determination. Both ovaries were removed, placed in a plastic bag, and labeled. As soon as possible after collection, the ovaries were removed from the plastic bag and boiled in water for ten minutes to loosen the mesentery and ovarian tissue. The ovaries were allowed to cool and were

# COMBINED SAMPLES

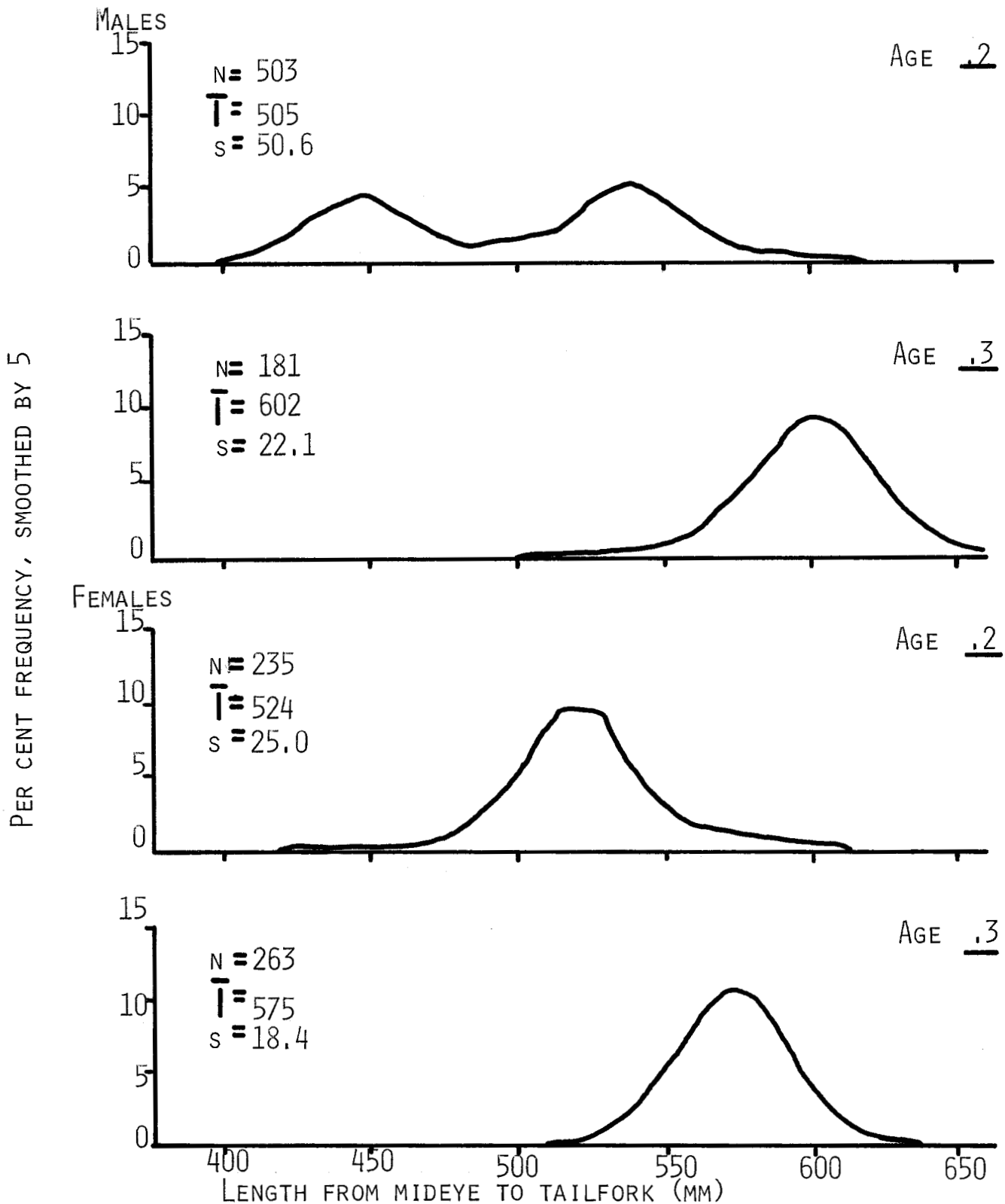


FIGURE 3. LENGTH-FREQUENCY DISTRIBUTION OF COMBINED RETURNING CHIGNIK SOCKEYE SALMON IN 1967, CLASSIFIED BY OCEAN AGE AND SEX. FREQUENCIES IN PER CENT, SMOOTHED BY A MOVING AVERAGE OF FIVE.

# MALES

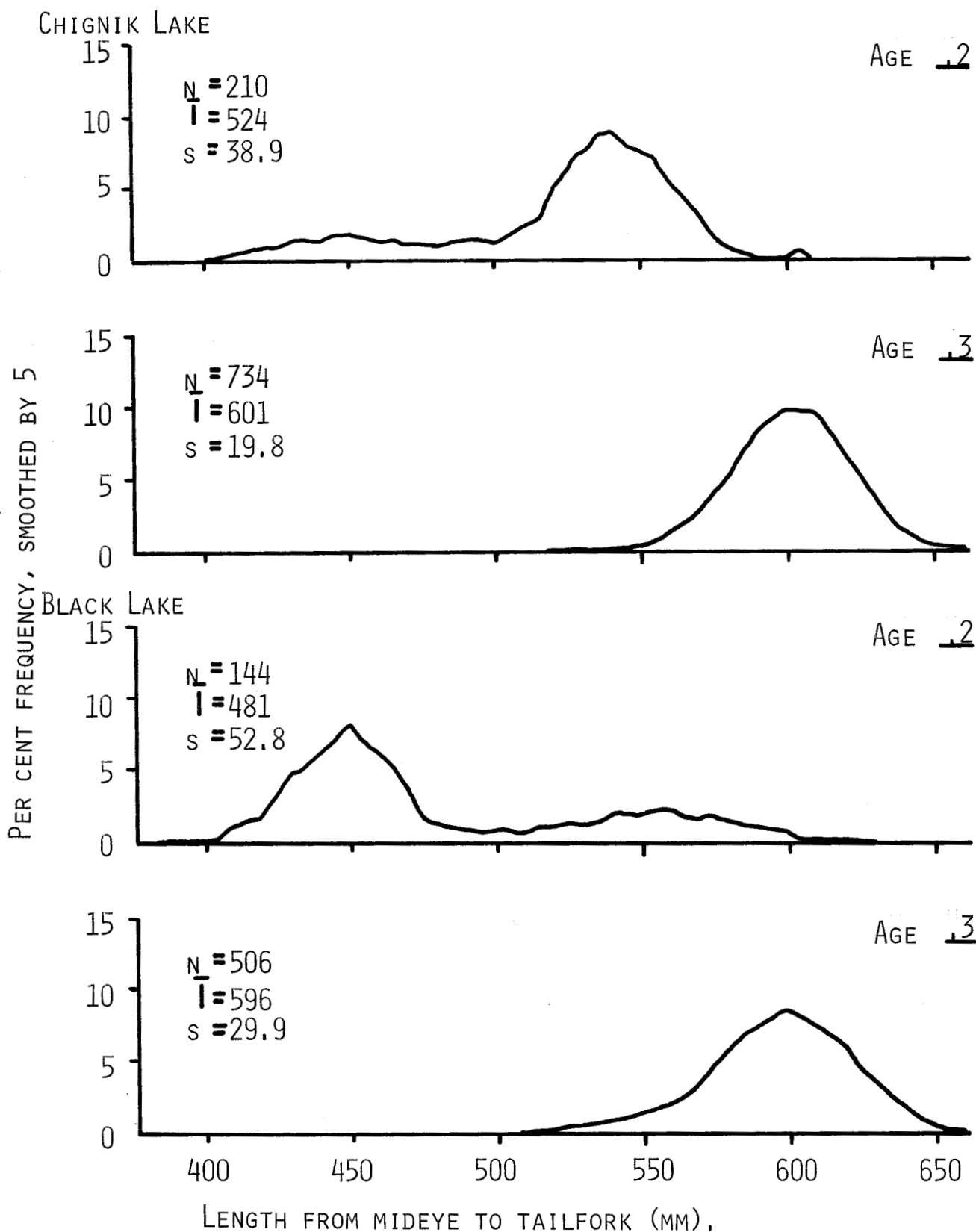
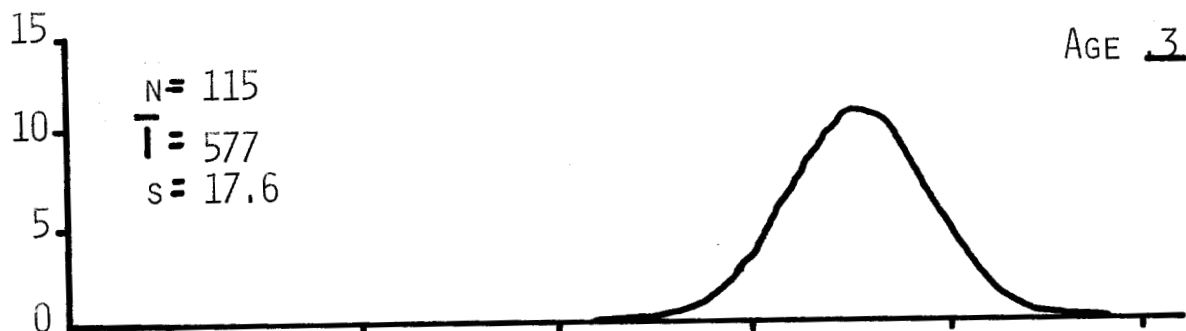
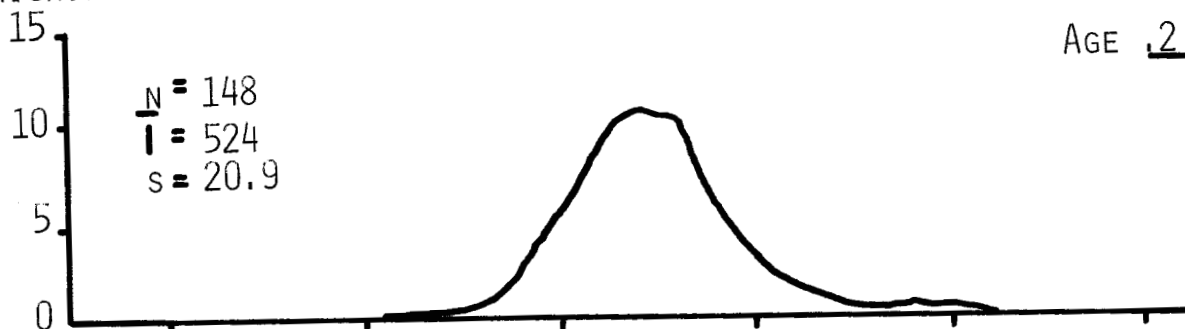


FIGURE 4. LENGTH-FREQUENCY DISTRIBUTION OF RETURNS OF MALE SOCKEYE SALMON RETURNING TO CHIGNIK IN 1967, CLASSIFIED BY OCEAN AGE AND STOCK.

# FEMALES

CHIGNIK LAKE



BLACK LAKE

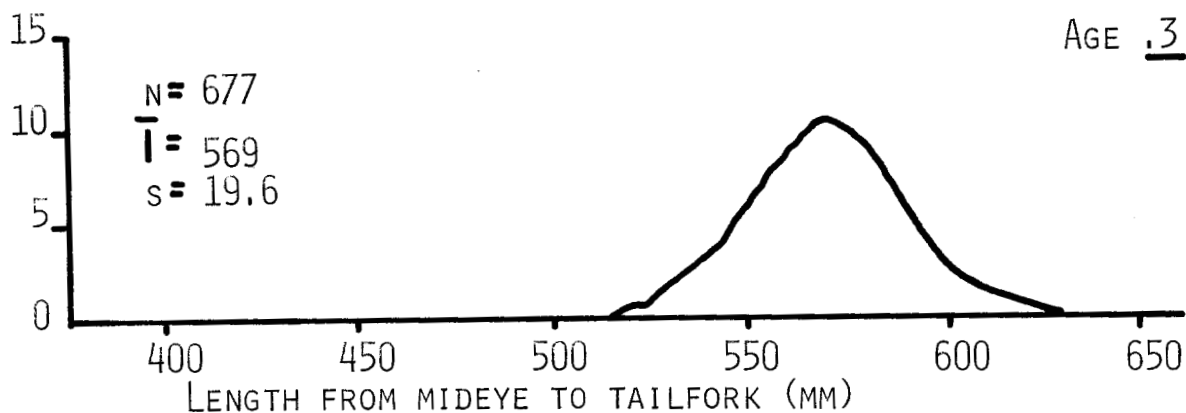
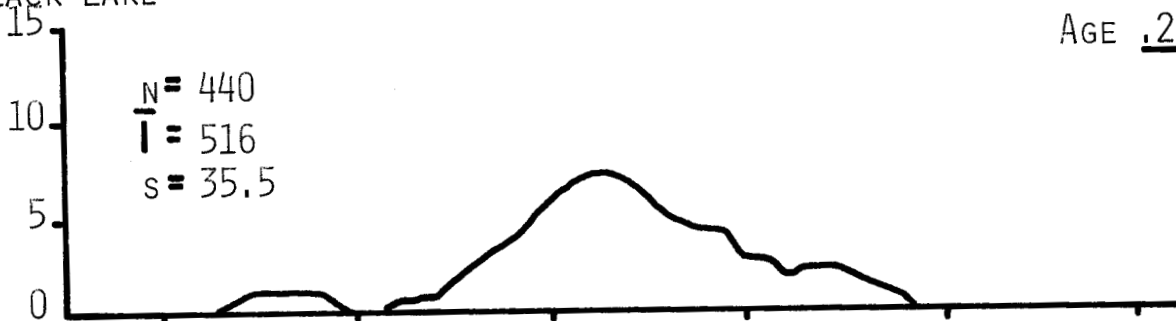


FIGURE 5. LENGTH-FREQUENCY DISTRIBUTION OF FEMALE SOCKEYE SALMON RETURNING TO CHIGNIK IN 1967, CLASSIFIED BY OCEAN AGE AND STOCK.

placed in a perforated plastic bag. The bag was immersed in a 10% formalin solution. After several days in formalin when the eggs had hardened, the ovaries were again removed from the plastic bag and rubbed between the hands until individual eggs emerged and all the ovarian tissue was removed. The eggs were then ready for counting.

The total number of eggs from the two ovaries was counted either manually or by use of an electronic counter of the type described by Davis and Paulik (1965). Samples counted manually were counted only once; those counted electronically were counted three or four times, and the mean count was used in the analysis.

### Analysis of Data and Results

Samples for determination of the fecundity relationship were collected for each stock on two occasions, each in a different year. A summary of the regression of number of eggs on length from mideye to tailfork (in millimeters) is presented in Table 11.

The first step in the analysis was to test whether or not the relationship between number of eggs and length was the same for samples within each stock. This hypothesis was accepted for both stocks (Table 12). The next step was to test the hypothesis that the regression of number of eggs on length from mideye to tailfork was the same for the pooled samples of the two stocks. This hypothesis was also accepted (Table 13). With our present data, we cannot detect a significant difference in fecundity-length relationship between years for the two stocks, and the pooled relationship is presently our best estimate for each stock. The individual and pooled relationships are all summarized in Table 11 and presented graphically in Figure 6.

### LENGTH-WEIGHT RELATIONSHIP

In 1966, samples were collected from the commercial fishery catch for determination of the length-weight relationship of the stocks. Samples were collected again in 1967 for information on the annual variation in this biological statistic. Data collected in 1967 are presented here and compared with the relationship in 1966.

### Sampling Procedure

Mature sockeye salmon were weighed and measured in conjunction with

TABLE 11. SUMMARY OF REGRESSION OF NUMBER OF EGGS ON MIDEYE TO TAILFORK LENGTH IN  
MM FOR CHIGNIK SOCKEYE SALMON

Stock	Year	Sample Size	Correlation Coefficient	Intercept $\alpha$	95% Confidence Limits for $\alpha$		Slope $\beta$	95% Confidence Limits for $\beta$	
					Lower	Upper		Lower	Upper
Black Lake	1961	29	0.4043*	-2317.633	-7877.503	3242.237	10.854	1.156	20.551
Chignik Lake	1961	17	0.7428	-8120.295	-14214.456	-2026.133	21.350	10.760	31.940
Black Lake	1965	85	0.3553**	-2323.420	-6141.717	1494.876	11.662	4.994	18.330
Chignik Lake	1967	50	0.4535**	-2041.425	-5602.781	1519.932	10.735	4.613	16.856
Black Lake	Combined	114	0.3318**	-2186.456	-5607.961	1235.505	11.220	5.246	17.193
Chignik Lake	Combined	67	0.5457**	-3727.492	-6740.545	-714.439	13.654	8.460	18.847
Combined	Combined	181	0.4023	-2535.863	-4789.205	-282.522	11.744	7.828	15.659

TABLE 12. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON  
LINE OF REGRESSION OF NUMBER OF EGGS ON LENGTH FROM  
MIDEYE TO TAILFORK FOR THE TWO SAMPLES FROM EACH STOCK

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
<u>Black Lake Stock</u>				
Due to Regression	452,371.93	2	226,186.0	1.00 NS
Individual Lines	24,705,039.7	110	224,591.3	
1965 Data	20,577,353.0	83		
1961 Data	4,127,686.7	27		
Common Line	29,228,759.0	112		
<u>Chignik Lake Stock</u>				
Due to Regression	685,838.7	2	342,919.4	1.77 NS
Individual Lines	12,140,643.3	63	192,708.6	
1967 Data	9,096,189.9	48		
1961 Data	3,044,453.4	15		
Common Line	12,826,482.0	65		

TABLE 13. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON  
LINE OF REGRESSION OF NUMBER OF EGGS ON LENGTH FROM  
MIDEYE TO TAILFORK FOR THE TWO STOCKS

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Due to Regression	866,060.0	2	433,030.0	1.82 NS (2,177)
Individual Lines	42,055,241.0	177	237,600.2	
Late Fish	29,228,759.0	112		
Early Fish	12,826,482.0	65		
Common Line	42,921,301.0	179		



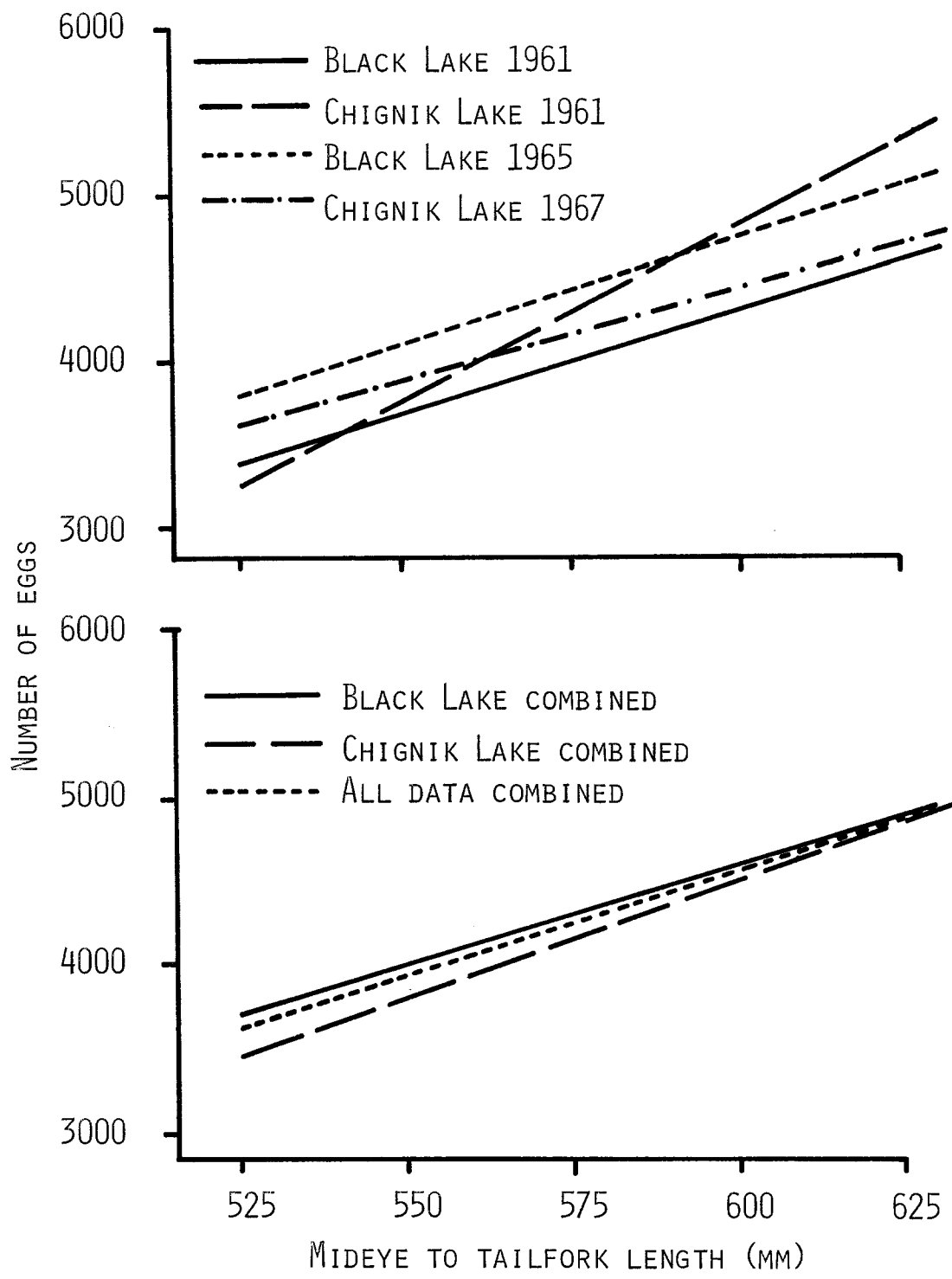


FIGURE 6, LINES OF REGRESSION OF NUMBER OF EGGS ON LENGTH FROM MIDEYE TO TAILFORK (MM).

the routine sampling program for determination of age composition of the 1967 run. The hand-purse-seine fishery is nonselective for size, therefore, samples of the commercial catch are assumed to be representative of the entire run. All measurements were taken aboard a cannery tender anchored in Chignik Lagoon. The fish were taken randomly from the seine-boat deliveries on 17 sampling dates. The fish were separated by sex, weighed to the nearest 10 g on a Chatillon autopsy scale, and measured from mid-eye to tailfork to the nearest millimeter. All fish were measured less than 12 hours after capture. A scale was taken from each fish for age determination. Observations were recorded on field forms and later transferred, together with age determinations, to punchcards for analysis.

### Analysis of Data and Results

Lengths from mid-eye to tailfork in millimeters and weights in grams (g) were fitted to the logarithmic forms of the general length-weight equation

$$\underline{W} = \underline{q} \underline{l}^{\delta}$$

$$\log_{10} (\underline{W}_i) = \log_{10} (\underline{q}_i) + \delta \log_{10} (\underline{l}_i),$$

which is a linear equation of the form

$$\underline{Y} = \alpha + \beta \underline{X}_i.$$

Using the information on time of entry given earlier in this report, we classified samples containing 90% late fish as being of Chignik Lake origin and those containing greater than 90% early fish as being of Black Lake origin (see Figure 1). Samples collected on days outside these limits were used in the analysis for the entire run but were disregarded in the analysis of the data by stock.

The first step in the analysis was to test the hypothesis that a common line would adequately fit the observed data for both sexes of both stocks. The hypothesis was strongly rejected (Table 14). However, the hypothesis that the slope was the same for all four groups was not rejected (Table 15). The length-weight relationship for 1967 Chignik sockeye salmon returns can be adequately described by a series of four parallel lines (Figure 7).

The possibility that within each stock the two sexes could be described by a common line was tested through an analysis of covariance. The hypothesis was strongly rejected for both stocks (Table 16).

TABLE 14. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON  
LINE OF REGRESSION OF  $\text{LOG}_{10}$  WEIGHT ON  $\text{LOG}_{10}$  LENGTH  
FOR EARLY AND LATE MALES AND FEMALES, 1967

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Common Regression	0.31286	6	0.05214	47.83** (6, 1205)
Individual Line	1.31567	1205	0.00109	
Black Lake Males	0.49241	358		
Black Lake Females	0.43231	374		
Chignik Lake Males	0.18947	193		
Chignik Lake Females	0.20148	280		
Common Line	1.62853	1211		

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TABLE 15. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON  
SLOPE OF REGRESSION OF  $\text{LOG}_{10}$  WEIGHT ON  $\text{LOG}_{10}$  LENGTH  
FOR EARLY AND LATE MALES AND FEMALES, 1967

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Deviation from Lines with Common Slope	1.33380	1208		
Deviation from Individual Lines	1.31567	1205	0.00109	
Due to Common Slope	0.01813	3	0.00604	0.55 NS (3, 1205)

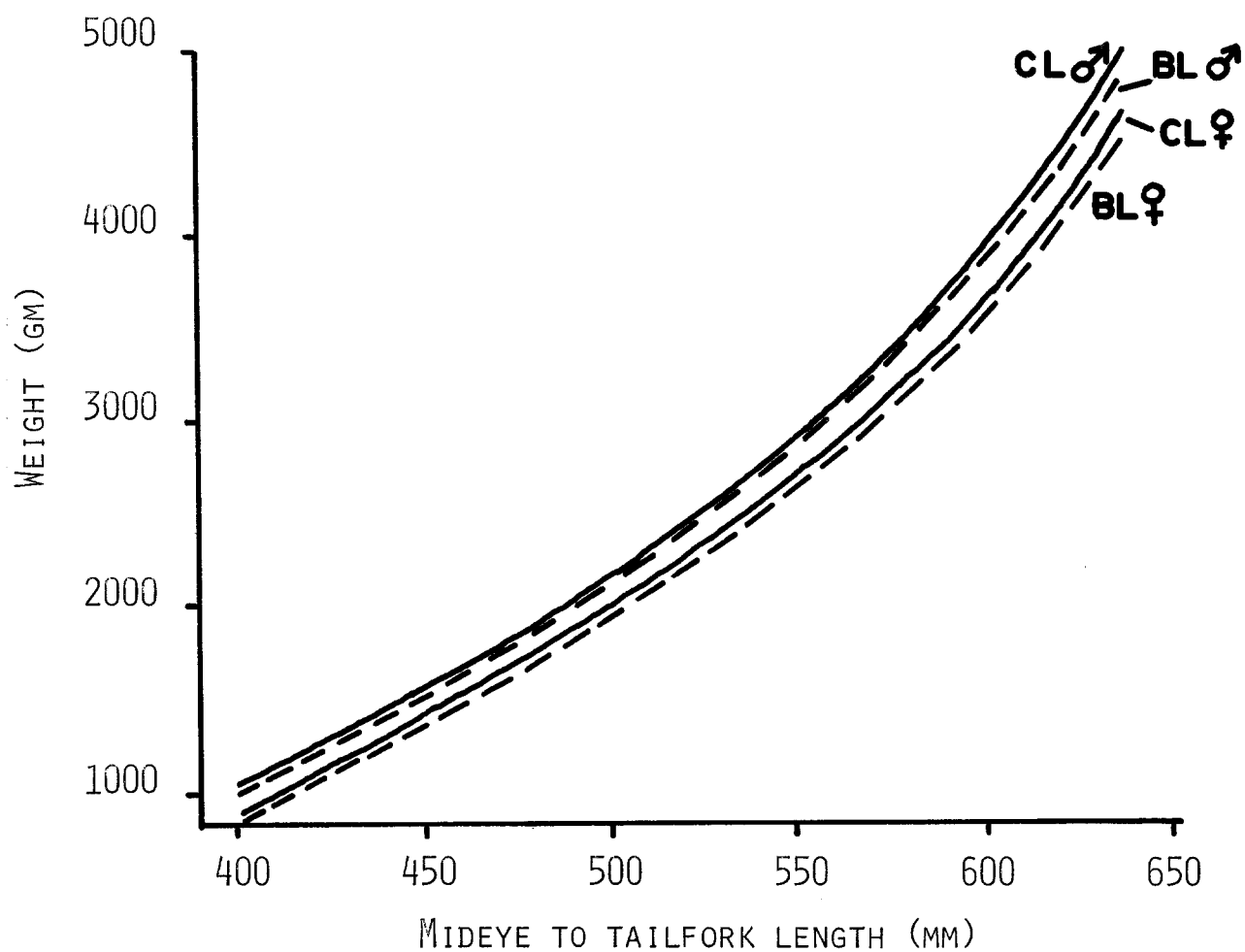


FIGURE 7. RELATIONSHIP BETWEEN WEIGHT AND LENGTH FOR CHIGNIK LAKE AND BLACK LAKE MALE AND FEMALE SOCKEYE SALMON IN 1967.

TABLE 16. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON  
LINE OF REGRESSION OF  $\text{LOG}_{10}$  WEIGHT ON  $\text{LOG}_{10}$  LENGTH  
FOR MALES AND FEMALES WITHIN STOCKS

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
<u>Black Lake</u>				
Common Regression	0.12616	2	0.06308	50.06** (2, 732)
Individual Lines	0.92472	732	0.00126	
Males	0.49241	358		
Females	0.43231	374		
Common Line	1.05088	734		
<u>Chignik Lake</u>				
Common Regression	0.17151	2	0.08576	103.33** (2, 473)
Individual Lines	0.39095	473	0.00083	
Males	0.18947	193		
Females	0.20148	280		
Common Line	0.56246	475		

Since data on length and weight were also available for the run in 1966, it was of interest to test the hypothesis that a common line would fit the data for the two years for each sex of each stock. The results of the analysis of covariance test was presented in Table 17. The hypothesis was rejected for all cases except Black Lake males. In all other cases, a common line did not fit the data as well as individual lines.

Similarly, the hypothesis of common slope was tested for the three groups for which the hypothesis of common line was rejected (Table 18). The hypothesis was rejected for Black Lake and Chignik Lake females but not for Chignik Lake males.

In summary, a common line adequately fits the length-weight observations for Black Lake males in 1966 and 1967. For Chignik Lake males, individual lines with common slope are adequate. For the females of both stocks, individual lines with different slopes and intercepts best fit the data.

The equations from regression of  $\log_{10}$  weight on  $\log_{10}$  length for Chignik sockeye salmon returns in 1967 are summarized in Table 19. The mean length and weight, ranges, and 95% confidence limits are presented in Table 20.

#### POTENTIAL EGG DEPOSITION

An estimate of the eggs available for deposition for the two stocks was calculated by the formula

$$\text{number of eggs} = \sum_{i=L}^U [(\alpha + \beta \frac{l_i}{5}) (N_{P_i})],$$

where  $\alpha$  and  $\beta$  are least-squares regression estimates from Table 11.

$\frac{l_i}{5}$  is the midpoint of the length interval  $\frac{l_i}{5}$  of female sockeye ( $L \leq \frac{l_i}{5} \leq U$ ),

$P_i$  is the proportion of females in the 5-mm length interval  $\frac{l_i}{5}$ , and

$N$  is the total escapement of females in 1967.

The estimates are presented in Table 21. They are not corrected for incomplete spawning or mortality of unspawned females.

TABLE 17. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON LINE  
RELATIONSHIP OF  $\text{LOG}_{10}$  WEIGHT ON  $\text{LOG}_{10}$  LENGTH FOR 1966  
AND 1967 BY STOCK AND SEX

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
<u>Black Lake Males</u>				
Regression	0.00215	2	0.00107	0.74 NS (2, 445)
Individual Lines	0.64757	445	0.00145	
1966	0.15516	87		
1967	0.49241	358		
Common Line	0.64972	447		
<u>Black Lake Females</u>				
Regression	0.02291	2	0.01145	7.95** (2, 466)
Individual Lines	0.67475	466	0.00144	
1966	0.24244	92		
1967	0.43231	374		
Common Line	0.69766	468		
<u>Chignik Lake Males</u>				
Regression	0.05041	2	0.02520	26.53** (2, 231)
Individual Lines	0.22053	231	0.00095	
1966	0.03106	38		
1967	0.18947	193		
Common Line	0.27094	233		
<u>Chignik Lake Females</u>				
Regression	0.15208	2	0.07604	79.21** (2, 374)
Individual Lines	0.36007	374	0.00096	
1966	0.15859	94		
1967	0.70148	280		
Common Line	0.51215	376		

TABLE 18. RESULTS OF ANALYSIS OF COVARIANCE TEST FOR COMMON SLOPE OF REGRESSION OF  $\text{LOG}_{10}$  WEIGHT ON  $\text{LOG}_{10}$  LENGTH FOR 1966 AND 1967 BY STOCK AND SEX

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
<u>Black Lake Females</u>				
Deviation from Lines with Common Slope	0.68558	467		
Deviation from Individual Lines	0.67475	466	0.00144	
Due to Common Slope	0.01083	1	0.01083	7.52** (1, 466)
<u>Chignik Lake Males</u>				
Deviation from Lines with Common Slope	0.22060	230		
Deviation from Individual Lines	0.22053	229	0.00096	
Due to Common Slope	0.00007	1	0.00007	0.07 NS (1, 229)
<u>Chignik Lake Females</u>				
Deviation from Lines with Common Slope	0.36664	373		
Deviation from Individual Lines	0.36007	372	0.00096	
Due to Common Slope	0.00657	1	0.00657	6.68 * (1, 372)



TABLE 19. SUMMARY OF LENGTH-WEIGHT RELATIONSHIP FOR 1967 CHIGNIK SOCKEYE SALMON ADULT RETURNS

Group	Sample Size	Correlation Coefficient	Intercept $\alpha$	95% Confidence Limit for $\alpha$		Slope $\beta$	95% Confidence Limit for $\beta$		t-value for test $\beta = 3$
				Lower	Upper		Lower	Upper	
All Fish	1,506	0.946**	-5.58803	-5.74558	-5.43049	3.29575	3.23864	3.35286	10.150**
All Males	676	0.971**	-5.40087	-5.56661	-5.23513	3.23422	3.17422	3.29423	7.651**
All Females	830	0.881**	-5.73125	-6.06803	-5.39448	3.34263	3.22042	3.46484	5.495**
All Black Lake	736	0.947**	-5.71243	-5.93902	-5.48584	3.34058	3.25841	3.42275	8.124**
Black Lake Males	360	0.968**	-5.56182	-5.80394	-5.31970	3.29082	3.20311	3.37852	6.499**
Black Lake Females	376	0.875**	-5.90626	-6.43137	-5.38116	3.40634	3.21572	3.59696	4.178**
All Chignik Lake	477	0.953**	-5.22190	-5.47262	-4.97118	3.16129	3.07041	3.25216	3.47873**
Chignik Lake Males	195	0.978**	-4.94453	-5.19801	-4.69106	3.06903	2.97730	3.16076	1.475
Chignik Lake Females	282	0.915**	-5.55435	-6.01915	-5.08955	3.27628	3.10763	3.44493	3.211**

TABLE 20. SUMMARY OF LENGTH AND WEIGHT PARAMETERS FOR RETURNS OF CHIGNIK SOCKEYE SALMON, 1967

Group and Sample Dates Included	Sample Size	Range of Lengths		Mean Length (ME-TF)	95% Confidence Limits for l		Range of Weights		Mean Weight	95% Confidence Limits for w	
		Lower	Upper		Lower	Upper	Lower	Upper		Lower	Upper
All Fish 6/7 - 8/4	1500	314mm 12.36in	661mm 26.02in	573mm 22.56in	570mm 22.44in	576mm 22.68	570g 1.26lb	5340g 11.77lb	3182g 7.02lb	3122g 6.89lb	3242g 7.15lb
All Males 6/7 - 8/4	676	314mm 12.36in	661mm 26.02in	578mm 22.76in	574mm 22.60in	582mm 22.91in	570g 1.26lb	5340g 11.77lb	3397g 7.50lb	3327g 7.34lb	3467g 7.65lb
All Females 6/7 - 8/4	830	468mm 18.43in	628mm 24.72in	570mm 22.44in	568mm 22.36in	572mm 22.52in	1560g 3.44lb	5250g 11.57lb	3018g 6.65lb	2968g 6.55lb	3050g 6.73lb
All Black Lake 6/7 - 6/28	736	400mm 15.75in	659mm 25.94in	572mm 22.52in	569mm 22.40in	575mm 22.64in	1100g 2.43lb	5250g 11.57lb	3152g 6.95lb	3096g 6.83lb	3208g 7.08lb
All Chignik Lake 7/12 - 8/4	477	314mm 12.36in	650mm 25.59in	574mm 22.60in	569mm 22.40in	579mm 22.80in	570g 1.26lb	5200g 11.46lb	3159g 6.96lb	3091g 6.82lb	3227g 7.12lb
Black Lake Males 6/7 - 6/28	360	400mm 15.75in	659mm 25.94in	578mm 22.68in	572mm 22.52in	584mm 22.99in	1100g 2.43lb	5250g 11.57lb	3320g 7.32lb	3272g 7.22lb	3368g 7.43lb
Black Lake Females 6/7 - 6/28	376	468mm 18.43in	628mm 24.72in	568mm 22.36in	566mm 22.28in	570mm 22.44in	1560g 3.44lb	4350g 9.59lb	2997g 6.61lb	2930g 6.46lb	3064g 6.76lb
Chignik Lake Males 7/12 - 8/4	195	314mm 12.36in	650mm 22.59in	579mm 22.80in	571mm 22.48in	587mm 23.11in	570g 1.26lb	5200g 11.46lb	3426g 7.55lb	3306g 7.29lb	3546g 7.82lb
Chignik Lake Females 7/12 - 8/4	282	496mm 19.53in	623mm 24.53in	570mm 22.44in	567mm 22.32in	573mm 22.55in	1620g 3.57lb	4200g 9.26lb	2986g 6.58lb	2935g 6.47lb	3037g 6.70lb

Table 21. Summary of potential egg deposition of returns in 1967  
for each spawning stock, Chignik sockeye salmon

Spawning stock	Total female escapement	Potential egg deposition (millions)	Potential egg deposition corrected for incomplete spawning (millions)
Black Lake	135,684	558.4	548.6
Chignik Lake	145,167	608.3	598.5
Total	280,851	1166.7	1147.1

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